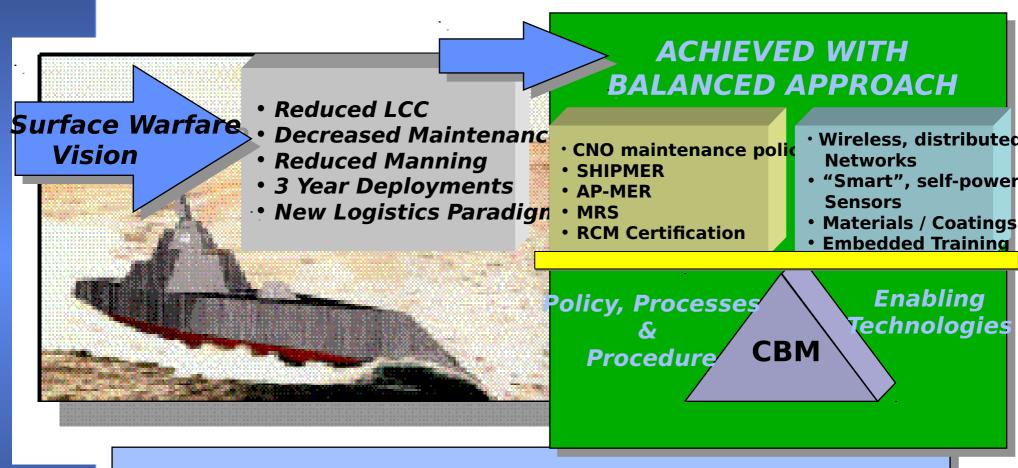


SEA 04RM Phillip Hans (SEA 04RM1)
Naval Sea Systems Command



CBM Transition



CBM - Enabler and Risk Reducer





RCM Is the Hub of CBM

CBM is a **Maintenance** Condition-Based Maintenance **Philosophy** preventive Maintenance Poing the Meed for Maintenance Maintenance — Doing Maintenance — Doing Maintenance RCM **RCM Provides** Rules of **Evidence**



Proof of RCM Success:

SHIP MERS

- Maintenance analysis using RCM principles
- Examines planned, preventive maintenance (PMS)
- Performed by In-Service Engineers (ISEs)
 - ▲ SEA 04RM provides training and logistics support

Progress to date

- SHIPMERs 1-54 completed
- Nearly 90% of all O-Level PMS reviewed

Documented SURFMER savings

 Exceeded CNO goal of 30% reduction of maintenance manhours

Road Map for applying CBM to Main Tasks (Second Filter) **AGE EFFECTIVENE Restores or DEGRADATION** SS **Maintains** (Third Filter) (First Filter) **Original** Verify Task Is Worth Reliability Requirement Step 1: **Exists** Step 5: **Step 4: Is the Existing Identify Failure Mode** Is the **Maintenance** (E.g., seized bearings) **Maintenance** Task Task Effective? Applicable? Step 2: **Apply Rules for Effectiveness** Does a **Significant Apply Rules for** Safety or the Environment Rate of Age **Applicability** (Law) Degradation Operational performance **TD:** Life Renewal Exist? (Mission) Yes Replace/Restore) No Yes All other failures Task Does **CD:** Health Monitoring Task Does Not Satisfy Satisfy No or **Significant** FF: Hidden Failure **Effectiveness Effectiveness** Acceptably Rate Rules Rules (Find/Repair) •Sample Vs 100% inspe Schedul **Slow Rate** of **Degradation** of S/L: SerVicing and Yes Make situational e Task Degradatio Redesign task Lubrication •Ndtask See other options Task Does **Task Does**

Step 3: **Applicability Applicability** Rules Rules **Determine/Classify Type Task** TIME-CONDITION- FAILURE- SERVICING Redesign LUBE Improve task DIR. DIR. **FINDING (S)** •"Fix when (L) failed.

(TD)

(CD)

(FF)

Not Satisfy

Improvement Option Goals

Step 6:

Satisfy

· Develop Recommendations for Cl

Continuous Improvement: periodi re-evaluation and adjustment of t



Choosing CBM Technology

- Can't afford it all
- Wouldn't all be worthwhile, anyway
- **How to choose?**
- RCM is the key
 - 1. Determine what maintenance you **need** to do
 - 2. Find CBM technology to support it





RCM Criteria for CBM-Enabling Technology

■ Failures Happen: Dominant Failure Modes

Failure mode is reasonably likely to occur

Applicability

- Monitored parameter really correlates to the failure mode; and
- Measures the parameter consistently and accurately; and
- Measurements serve as an accurate indicator of required repair action; and
- There is adequate time for corrective action before functional failure.





RCM Criteria for CBM-Enabling Technology (cont.)

Effectiveness

- *Safety:* Identifies repair threshold in time to reduce probability of failure to acceptable level; **or**
- *Mission:* Identifies repair threshold in time to reduce risk of failure (probability times severity) to acceptable level; **or**
- *Economics:* Identifies repair threshold in time to reduce cost to identify and prevent failure at less cost than repairing after run to failure.



Other Considerations

■ CBM does not eliminate the need for maintenance

- CBM technology has Ao and maintenance needs
- Deterioration may occur no matter what the maintenance approach
- Goal is to maintain or restore reliability at *least* cost
- May allow operator to secure an equipment before occurrence of disruptive and more costly failure

Costs considered in determination of effectiveness

- Hardware and software acquisition
- Development of operating procedures and parametric values vs. deterioration for monitored equipment
- ILS costs, including training





Conclusions

- Application of CBM technology can crucial to a successful CBM transition
- But only worthwhile technology should be applied
- A CBM-enabling technology may be worthwhile only if:
 - There is a specific failure mode that is reasonably likely to occur
 - The technology can accurately and consistently be used to predict the onset of the failure mode
 - The technology allows operators and maintainers to take appropriate action that reduces probability of failure (safety), risk of failure (mission), or cost of prevention to acceptable levels
 - The technology "pays for itself" in terms of increased Ao or reduced maintenance costs.